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On Neutrosophic Z-algebras

Sahar Jaafar Mahmood [a], Adel Salim Tayyah [a] and Dhirgam Allawy Hussein [b*]

[a] Department of Multimedia, College of Computer Science and Information Technology, University of Al-Qadisiyah, P.O.Box-88, Al Diwaniyah, Al-Qadisiyah, Iraq.
[b] Directorate of Education in Al-Qadisiyah, Diwaniyah, Iraq.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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Abstract

This study presents the notion of neutrosophic Z-algebra and neutrosophic pseudo Z-algebra explores some of its properties. Also studied are the neutrosophic Z-ideal, neutrosophic Z-sub algebra, and neutrosophic Z-filter. Several properties are discovered, and some findings from the study of homomorphism are discussed.

Keywords: Neutrosophic Z-algebra; neutrosophic pseudo Z-algebra; neutrosophic Z-sub algebra; neutrosophic Z-ideal; neutrosophic Z-filter.

1 Introduction

Smarandache established the area of philosophy known as neutrosophy, which has a many implementations in the real world and in mathematics, particularly in algebra [1].also gave more information about neutrosophy see [2,3]. making use of neutrosophic theory Kandasamy and Smarandache [4] in 2004 suggested a set-based algebraic structure of neutrosophic numbers of the type $\mathcal{N} = ꜫ + \dagger\mathcal{J}$ that they dubbed $\mathcal{J}$-Neutrosophic Algebraic Structure. ,where $ꜫ, \dagger \in \mathbb{R}\ or\ \mathbb{C}$, and $\mathcal{J}$ which means indetermined or uncertain thus that $\mathcal{J}^2 = \mathcal{J}$,is referred to as literal indeterminacy, here $ꜫ$ is referred to as the $\mathcal{N}'$s determinate portion, and $\dagger\mathcal{J}$ is referred to as its indeterminate portion on $\mathcal{N}$,with $g\mathcal{J} + h\mathcal{J} = (g + h)\mathcal{J}$, $0 . \mathcal{J} = 0$. Where $\mathcal{J}$ is different from the

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**Corresponding author: Email: dhirgam.allawy@qu.edu.iq, dhirgam82@gmail.com;*

imaginary $i^2 = -1$, in general, $\mathcal{I}^{j} = \mathcal{I}\ \ if\ \ j > 0$, and is unknown for $j \leq 0$. In 2006, the idea of neutrosophic algebraic structures was also proposed [5].

In [6,7,8,9], the idea of neutrosophic BCI/BCK –algebras, neutrosophic KU-algebras and neutrosophic B-algebras was presented.

Z-algebra is an unique algebraic structure based on logic that was first proposed in 2017 by Chandramouleeswaran et al. [10].

[11] and [12] They provided characteristics and further explanation of Z-algebra.

In this article, we explain the idea of neutrosophic Z-algebra, look at various relevant characteristics, examine a neutrosophic Z-homomorphism, and present some findings.

2 Preliminaries

Definition 2.1: [1] A neutronsophic set $\mathcal{X}(\mathcal{I}) = \langle \mathcal{X}, \mathcal{I} \rangle = \{\mathcal{x} + \mathcal{y}\mathcal{I} : \mathcal{x}, \mathcal{y} \in \mathcal{X}\}$, where $\mathcal{X}\ \neq \phi$ and $\mathcal{I}$ an indeterminate .

Definition 2.2: [10] let $\mathcal{Z} \neq \phi$ and $*$ is a binary operation with constant 0 then the algebra $(\mathcal{Z},*,0)$ named Z-Algebra if satisfying the following axiom:

$\mathcal{Z}_1$: $\mathcal{x} * 0 = 0$
$\mathcal{Z}_2$: $0 * \mathcal{x} = \mathcal{x}$
$\mathcal{Z}_3$: $\mathcal{x} * \mathcal{x} = \mathcal{x}$
$\mathcal{Z}_4$: $\mathcal{x} * \mathcal{y} = \mathcal{y} * \mathcal{x}$ When $\mathcal{x} \neq 0$ and $\mathcal{y} \neq 0, \forall \mathcal{x}, \mathcal{y} \in \mathcal{Z}$.

Definition 2.3: [10] Let $\delta \neq \phi$ and $\delta \subseteq \mathcal{Z}$ where $(\mathcal{Z},*,0)$is a Z-Algebra, δ is named Z-subalgebra if $\mathcal{x} * \mathcal{y} \in \delta$, $\forall \mathcal{x}, \mathcal{y} \in \delta$.

Definition 2.4: [10] Let $\mathcal{I} \neq \phi$ and $\mathcal{I} \subseteq \mathcal{Z}$, where $(\mathcal{Z},*,0)$is a Z-Algebra, $\mathcal{I}$ is named

Z-ideal of $\mathcal{Z}$ if satisfy (1) $0 \in \mathcal{I}$ (2) $\mathcal{x} * \mathcal{y} \in \mathcal{I}$, and $\mathcal{y} \in \mathcal{I} \Rightarrow \mathcal{x} \in \mathcal{I}$.

Definition 2.5: [11] Let $\mathcal{I} \neq \phi$ and $\mathcal{I} \subseteq \mathcal{Z}$, where $(\mathcal{Z},*,0)$ is a Z-Algebra, $\mathcal{I}$ is named $\mathrm{Z}_1 -$ ideal of $\mathcal{Z}$ if satisfy

(1) $0 \in \mathcal{I}$ (2) $((\mathcal{x} * \mathcal{z}) * \mathcal{x}) * \mathcal{y} \in \mathcal{I}$, and $\mathcal{y} \in \mathcal{I} \Rightarrow \mathcal{x} \in \mathcal{I}, \forall\ \mathcal{x}, \mathcal{y}, \mathcal{z} \in \mathcal{Z}$.

Definition 2.6: [11] Let $\mathcal{I} \neq \phi$ and $\mathcal{I} \subseteq \mathcal{Z}$, where $(\mathcal{Z},*,0)$is a Z-Algebra, $\mathcal{I}$ is named Z_2 −ideal of $\mathcal{Z}$ if satisfy

(1) $0 \in \mathcal{I}$ (2) $(\mathcal{x} * \mathcal{z}) * (\mathcal{x} * \mathcal{y}) \in \mathcal{I}$, and $\mathcal{y} \in \mathcal{I} \Rightarrow \mathcal{x} \in \mathcal{I}, \forall\ \mathcal{x}, \mathcal{y}, \mathcal{z} \in \mathcal{Z}$

Definition 2.7: [12] Let $\mathcal{I} \neq \phi$ and $\mathcal{I} \subseteq \mathcal{Z}$, where $(\mathcal{Z},*,0)$is a Z-Algebra, $\mathcal{I}$ is named Z_P −ideal of $\mathcal{Z}$ if satisfy

(1) $0 \in \mathcal{I}$ (2) $(\mathcal{x} * \mathcal{z}) * (\mathcal{y} * \mathcal{z}) \in \mathcal{I}$, and $\mathcal{y} \in \mathcal{I} \Rightarrow \mathcal{x} \in \mathcal{I}, \forall\ \mathcal{x}, \mathcal{y}, \mathcal{z} \in \mathcal{Z}$.

Definition 2.8: [10] let $\mathcal{F} \neq \phi$ and $\mathcal{F} \subseteq \mathcal{Z}$, where $(\mathcal{Z},*,0)$is a Z-Algebra, $\mathcal{F}$is named $\mathcal{Z}$-filter of $\mathcal{Z}$ if $\mathcal{x} \Delta \mathcal{y} = \mathcal{x} * (\mathcal{x} * \mathcal{y}) \in \mathcal{F}, \forall\ \mathcal{x}, \mathcal{y} \in \mathcal{F}, (\mathcal{x} \neq \mathcal{y})$.

Example 2.9: let $\mathcal{Z} = \{0, \mathcal{x}, \mathcal{y}, \mathcal{z}\}$ be set and $*$ is a binary operation defined on $\mathcal{Z}$ by the table:

$*$	**0**	$\mathcal{x}$	$\mathcal{y}$	$\mathcal{z}$
0	0	$\mathcal{x}$	$\mathcal{y}$	$\mathcal{z}$
$\mathcal{x}$	0	$\mathcal{x}$	$\mathcal{y}$	$\mathcal{y}$
$\mathcal{y}$	0	$\mathcal{y}$	$\mathcal{y}$	$\mathcal{y}$
$\mathcal{z}$	0	$\mathcal{y}$	$\mathcal{y}$	$\mathcal{z}$

Then $(\mathcal{Z},*,0)$ is Z-Algebra. $\delta = \{ϩ, ϯ, ϡ\}$ is Z-subalgebra and $\mathcal{I} = \{0, ϩ, ϯ\}$ is a Z_1 –ideal, $\mathcal{I}^{\$} = \{0, ϩ, ϡ\}$ is a (Z_2 -ideal , Z_p –ideal) Z-ideal .and $\mathcal{F} = \{ϩ, ϯ\}$ is $\mathcal{Z}$-filter .

Note : every (Z_1– ideal , Z_2 –ideal) is an ideal of $\mathcal{Z}$.

Definition 2.10: [11] Let $\mathcal{Z} \neq ϕ$ with two binary operations $*$,⊛ and constant 0 then the algebra $(\mathcal{Z},*,⊛,0)$ named pseudo Z-Algebra (briefly,P$\mathcal{Z}$) if satisfying the following axiom:

$P\mathcal{Z}_1$: $ϩ * 0 = ϩ ⊛ 0 = 0$
$P\mathcal{Z}_2$: $0 * ϩ = 0 ⊛ ϩ = ϩ$
$P\mathcal{Z}_3$: $ϩ * ϩ = ϩ ⊛ ϩ = ϩ$
$P\mathcal{Z}_4$: $ϩ * ϯ = ϯ ⊛ ϩ$ When $ϩ \neq 0$ and $ϯ \neq 0, \forall\ ϩ, ϯ \in \mathcal{Z}$.

Definition 2.11: [11] Let $\delta \neq ϕ$ and $\delta \subseteq \mathcal{Z}$, where $(\mathcal{Z},*,⊛,0)$is P$\mathcal{Z}$ then δ is named a pseudo Z-subalgebra if $ϩ * ϯ,\ ϩ ⊛ ϯ \in \delta, \forall ϩ, ϯ \in \delta$.

Example 2.12: Let $\mathcal{Z} = \{0, ϩ, ϯ, ϡ\}$ be set and $*$,⊛ are a binary operations defined on $\mathcal{Z}$ by the table as follows:

*	0	ϩ	ϯ	ϡ	⊛	0	ϩ	ϯ	ϡ
0	0	ϩ	ϯ	ϡ	0	0	ϩ	ϯ	ϡ
ϩ	0	ϩ	ϩ	ϯ	ϩ	0	ϩ	ϯ	ϩ
ϯ	0	ϯ	ϯ	ϩ	ϯ	0	ϩ	ϯ	ϩ
ϡ	0	ϩ	ϩ	ϡ	ϡ	0	ϯ	ϩ	ϡ

Then $(\mathcal{Z},*,⊛,0)$ is pseudo Z-algebra , $\delta = \{ϩ, ϯ, ϡ\}$ is a pseudo Z-sub algebra.

3 Neutrosophic Z-algebra

Definition 3.1: A neutrosophic Z-algebra is the triple $\big(\mathcal{Z}(\mathcal{I}),*,(0,0\mathcal{I})\big)$ (briefly,$\mathcal{N}\mathcal{Z}$) (where $(\mathcal{Z},*,0)$be a Z-algebra , $\mathcal{Z}(\mathcal{I}) = \langle \mathcal{Z}, \mathcal{I} \rangle$ a neutrosophic set)

if $(ϩ, ƀ\mathcal{I}), (ϯ, ϥ\mathcal{I})$ are any two elements of $\mathcal{Z}(\mathcal{I})$ with $ϩ, ƀ, ϯ, ϥ \in \mathcal{Z}$ satisfies

$(ϩ, ƀ\mathcal{I}) * (ϯ, ϥ\mathcal{I}) = (ϩ * ϯ, (ϩ * ϥ \wedge ƀ * ϯ \wedge ƀ * ϥ)\mathcal{I})$

An element $ϩ \in \mathcal{Z}$ is represented by $(ϩ, 0\mathcal{I}) \in \mathcal{Z}(\mathcal{I})$,

$(ϩ, 0\mathcal{I}) * (ƀ, 0\mathcal{I}) = (ϩ * ƀ, 0\mathcal{I}) = (ϩ \wedge\!\backsim ƀ, 0)$. where $\backsim ƀ$ is the negation of ƀ in $\mathcal{Z}$

And $(ϩ, ƀ\mathcal{I}) = (ϯ, ϥ\mathcal{I}) \Leftrightarrow (ϩ = ϯ$ and $ƀ = ϥ)$

Definition 3.2: A neutrosophic pseudo Z-algebra is $(\mathcal{Z}(\mathcal{I}),*,⊛,(0,0\mathcal{I}))$ (briefly,$\mathcal{N}$P$\mathcal{Z}$) (where $(\mathcal{Z},*,⊛,0)$be a pseudo Z-algebra

If $(ϩ, ƀ\mathcal{I}), (ϯ, ϥ\mathcal{I})$ are any two elements of $\mathcal{Z}(\mathcal{I})$ with $𝔵, ƀ, ϯ, ϥ \in \mathcal{Z}$ satisfies

$(ϩ, ƀ\mathcal{I}) * (ϯ, ϥ\mathcal{I}) = (ϩ * ϯ, (ϩ * ϥ \wedge ƀ * ϯ \wedge ƀ * ϥ)\mathcal{I})$

$(ϯ, ϥ\mathcal{I}) ⊛ (ϩ, ƀ\mathcal{I}) = (ϯ ⊛ ϩ, (ϩ ⊛ ϥ \wedge ƀ ⊛ ϯ \wedge ƀ ⊛ ϥ)\mathcal{I})$

Where $(ϩ, ƀ\mathcal{I}) * (ϯ, ϥ\mathcal{I}) = (ϩ, ƀ\mathcal{I}) ⊛ (ϯ, ϥ\mathcal{I})$
When$(ϩ, ƀ\mathcal{I}) \neq (0,0\mathcal{I})$ and $(ϯ, ϥ\mathcal{I}) \neq (0,0\mathcal{I}), \forall\ (ϩ, ƀ\mathcal{I}), (ϯ, ϥ\mathcal{I}) \in \mathcal{Z}(\mathcal{I})$

Theorem 3.3: Every $\mathcal{N}\mathcal{Z}$ $\big(\mathcal{Z}(\mathcal{I}),*,(0,0\mathcal{I})\big)$ with condition $(0,0\mathcal{I}) * (ϩ, ƀ\mathcal{I}) = (ϩ, ƀ\mathcal{I})$ is a $\mathcal{Z}$ –algebra and conversely, not.

Proof: let $\big(\mathcal{X}(\mathcal{J}),*,(0,0\mathcal{J})\big)$ is $\mathcal{NZ}$

Let $\mathscr{r} = (Ꝛ\,,ꞗ\mathcal{J})$ and $0 = (0,0\mathcal{J})$

$\mathcal{Z}_1$: $\mathscr{r} * 0 = (Ꝛ\,,ꞗ\mathcal{J}) * (0,0\mathcal{J}) = (Ꝛ * 0,(Ꝛ * 0 \wedge ꞗ * 0)\mathcal{J}) = (0,(0 \wedge 0)\mathcal{J}) = (0,0\mathcal{J})$
$\mathcal{Z}_2$: $0 * \mathscr{r} = (0,0\mathcal{J}) * (Ꝛ\,,ꞗ\mathcal{J}) = (0 * Ꝛ,(0 * ꞗ \wedge 0 * Ꝛ)\mathcal{J}) = (Ꝛ,(ꞗ \wedge Ꝛ)\mathcal{J}) = (Ꝛ,ꞗ\,\mathcal{J})$
$\mathcal{Z}_3$: $\mathscr{r} * \mathscr{r} = (Ꝛ\,,ꞗ\mathcal{J}) * (Ꝛ\,,ꞗ\mathcal{J}) = (Ꝛ * Ꝛ,(Ꝛ * ꞗ \wedge ꞗ * Ꝛ \wedge ꞗ * ꞗ)\mathcal{J})$
$= (Ꝛ,(Ꝛ \wedge\backsim ꞗ \wedge ꞗ \wedge\backsim Ꝛ \wedge ꞗ)\mathcal{J})$
$= (Ꝛ\,,ꞗ\mathcal{J})$
$\mathcal{Z}_4$: $\mathit{if}\ \ \mathscr{r} * \mathscr{s} = \mathscr{s} * \mathscr{r}$,when $\mathscr{r} \neq 0\ \ \&\ \ \mathscr{s} \neq 0, \forall\ \mathscr{r},\mathscr{s} \in \mathcal{Z}(\mathcal{J})$

$\mathit{let}\ \ \mathscr{r} = (Ꝛ\,,ꞗ\mathcal{J}), \mathscr{s} = (ϯ\,,Ч\mathcal{J})$,

$(Ꝛ\,,ꞗ\mathcal{J}) * (ϯ\,,Ч\mathcal{J}) = (ϯ\,,Ч\mathcal{J}) * (Ꝛ\,,ꞗ\mathcal{J})$

$(Ꝛ * ϯ,(Ꝛ * Ч \wedge ꞗ * ϯ \wedge ꞗ * Ч)\mathcal{J}) = (ϯ * Ꝛ,(ϯ * ꞗ \wedge Ч * Ꝛ \wedge Ч * ꞗ)\mathcal{J})$

Suppose $(Ꝛ,ꞗ\,\mathcal{J}) \neq (0,0\mathcal{J})$ & $(ϯ,Ч\mathcal{J}) \neq (0,0\mathcal{J})$ we get

$0 * ϯ = ϯ * 0 \quad \Rightarrow ϯ = 0$

and $0 * Ч \wedge 0 * 0 = 0 * 0 \wedge Ч * 0 \ \Rightarrow\ Ч = 0$

We get a contradiction.

Then $\big(\mathcal{Z}(\mathcal{J}),*,(0,0\mathcal{J})\big)$ is a Z-algebra.

Theorem 3.4: Every $\mathcal{N}\mathrm{P}\mathcal{Z}$, $(\mathcal{Z}(\mathcal{J}),*,\circledast,(0,0\mathcal{J}))$ with condition$(0,0\mathcal{J}) * (Ꝛ\,,ꞗ\mathcal{J}) = (Ꝛ\,,ꞗ\mathcal{J}), (0,0\mathcal{J}) \circledast (Ꝛ\,,ꞗ\mathcal{J}) = (Ꝛ\,,ꞗ\mathcal{J})$ is a pseudo $\mathcal{Z}$ -algebra and conversely, not.

Proof: it is easy as above.

Definition 3.5: Let $\mathfrak{S}(\mathcal{J}) \neq ɸ$ and $\mathfrak{S}(\mathcal{J}) \subseteq \mathcal{Z}(\mathcal{J})$, $\big(\mathcal{Z}(\mathcal{J}),*,(0,0\mathcal{J})\big)$ is $\mathcal{NZ}$,$\mathfrak{S}(\mathcal{J})$ is named a neutrosophic Z-subalgebra (briefly, $\mathcal{NZ}^{\mathscr{s}}$) of $\mathcal{Z}(\mathcal{J})$ if

1) $(0,0\mathcal{J}) \in \mathfrak{S}(\mathcal{J})$
2) $(Ꝛ\,,ꞗ\mathcal{J}) * (ϯ\,,Ч\mathcal{J}) \in \mathfrak{S}(\mathcal{J}), \forall (Ꝛ\,,ꞗ\mathcal{J}),(ϯ\,,Ч\mathcal{J}) \in \mathfrak{S}(\mathcal{J})$
3) $\mathfrak{S}(\mathcal{J})$Contains a proper sub set which a Z-algebra.

Definition 3.6: Let $\mathfrak{S}(\mathcal{J}) \neq ɸ$ and $\mathfrak{S}(\mathcal{J}) \subseteq \mathcal{Z}(\mathcal{J})$, $(\mathcal{Z}(\mathcal{J}),*,\circledast,(0,0\mathcal{J})$is $\mathcal{N}\mathrm{P}\mathcal{Z}$, $\mathfrak{S}(\mathcal{J})$ is called a neutrosophic pseudo Z-subalgebra (briefly, $\mathcal{N}\mathrm{P}\mathcal{Z}^{\mathscr{s}}$) of $\mathcal{Z}(\mathcal{J})$ if

1) $(0,0\mathcal{J}) \in \mathfrak{S}(\mathcal{J})$
2) $(Ꝛ\,,ꞗ\mathcal{J}) * (ϯ\,,Ч\mathcal{J}) \in \mathfrak{S}(\mathcal{J})\ \&\ (Ꝛ\,,ꞗ\mathcal{J}) \circledast (ϯ\,,Ч\mathcal{J}) \in \mathfrak{S}(\mathcal{J}), \forall (Ꝛ\,,ꞗ\mathcal{J}),(ϯ\,,Ч\mathcal{J}) \in \mathfrak{S}(\mathcal{J})$
3) $\mathfrak{S}(\mathcal{J})$Contains a proper sub set which a pseudo Z-algebra.

Theorem 3.7: If $\mathcal{A}_{(ɷ,ɷ\mathcal{J})}(\mathcal{J}) \neq ɸ$ and $\mathcal{A}_{(ɷ,ɷ\mathcal{J})}(\mathcal{J}) \subseteq \mathcal{Z}(\mathcal{J})$ for $ɷ \neq 0$, $\big(\mathcal{Z}(\mathcal{J}),*,(0,0\mathcal{J})\big)$ is $\mathcal{NZ}$ **,**where $\mathcal{A}_{(ɷ,ɷ\mathcal{J})}(\mathcal{J}) = \{(Ꝛ\,,ꞗ\mathcal{J}) \in \mathcal{Z}(\mathcal{J}) : (Ꝛ\,,ꞗ\mathcal{J}) * (ɷ,ɷ\mathcal{J}) = (ɷ,ɷ\mathcal{J})\}$

Then 1) $\mathcal{A}_{(ɷ,ɷ\mathcal{J})}(\mathcal{J})$ is $\mathcal{NZ}^{\mathscr{s}}$.
2) $\mathcal{A}_{(ɷ,ɷ\mathcal{J})}(\mathcal{J}) \subseteq \mathcal{A}_{(0,0I)}(\mathcal{J})$.

Proof: 1) clearly $(0,0\mathcal{J}) \in \mathcal{A}_{(ɷ,ɷ\mathcal{J})}(\mathcal{J})$

$\mathcal{A}_{(ɷ,ɷ\mathcal{J})}(\mathcal{J})$ contain a proper sub set which a Z-algebra.

Let $(Ƨ\,,ꞗ\mathcal{J}),(ϯ\,,Ч\mathcal{J}) \in \mathcal{A}_{(ω,ω\mathcal{J})}(\mathcal{J}) \Rightarrow$
$(Ƨ\,,ꞗ\mathcal{J}) * (ω,ω\mathcal{J}) = (ω,ω\mathcal{J})$, $(ϯ\,,Ч\mathcal{J}) * (ω,ω\mathcal{J}) = (ω,ω\mathcal{J}) \Rightarrow$

$Ƨ * ω = ω\,,\ Ƨ * ω \wedge ꞗ * ω = ω$ & $ϯ * ω = ω\,, ϯ * ω \wedge Ч * ω = ω$ since $ω \neq 0 \Rightarrow$
$Ƨ = ꞗ = ϯ = Ч = ω$

$$\begin{aligned}[(Ƨ\,,ꞗ\mathcal{J}) * (ϯ\,,Ч\mathcal{J})] * (ω,ω\mathcal{J}) &= [Ƨ * ϯ, (Ƨ * Ч \wedge ꞗ * ϯ)\mathcal{J}] * (ω,ω\mathcal{J}) \\ &= \big[(Ƨ * ϯ) * ω\,, \big((Ƨ * ϯ) * ω \wedge (Ƨ * Ч \wedge ꞗ * ϯ) * ω\big)\mathcal{J}\big] \\ &= [ω * ω, (ω * ω \wedge ω * ω)\mathcal{J}] \\ &= (ω,ω\mathcal{J})\end{aligned}$$

This shows that $(Ƨ\,,ꞗ\mathcal{J}) * (ϯ\,,Ч\mathcal{J}) \in \mathcal{A}_{(ω,ω\mathcal{J})}(\mathcal{J})$
Then $\mathcal{A}_{(ω,ω\mathcal{J})}(\mathcal{J})$ is $\mathcal{N}\mathcal{Z}^{s}$.
(2) it's easy.

Theorem 3.8: If $\mathcal{A}_{(ω,ω\mathcal{J})}(\mathcal{J}) \neq \phi$ and $\mathcal{A}_{(ω,ω\mathcal{J})}(\mathcal{J}) \subseteq \mathcal{Z}(\mathcal{J})$, for $ω \neq 0$,

$(\mathcal{Z}(\mathcal{J}),*,\circledast,(0,0\mathcal{J})$ is $\mathcal{N}\mathrm{P}\mathcal{Z}$**,** where $\mathcal{A}_{(ω,ω\mathcal{J})}(\mathcal{J}) = \{(Ƨ\,,ꞗ\mathcal{J}) \in \mathcal{Z}(\mathcal{J}) : (Ƨ\,,ꞗ\mathcal{J}) * (ω,ω\mathcal{J}) = (ω,ω\mathcal{J})$ & $(Ƨ\,,ꞗ\mathcal{J}) \circledast$ *ω,ωℐ=ω,ωℐ*

Then 1) $\mathcal{A}_{(ω,ω\mathcal{J})}(\mathcal{J})$ is $\mathcal{N}\mathrm{P}\mathcal{Z}^{s}$.
2) $\mathcal{A}_{(ω,ω\mathcal{J})}(\mathcal{J}) \subseteq \mathcal{A}_{(0,0\mathcal{J})}(\mathcal{J})$.

Proof: it is easy as above.

Theorem 3.9: If $\mathcal{Z}_{\xi}(\mathcal{J}) \neq \phi$ and $\mathcal{Z}_{\xi}(\mathcal{J}) \subseteq \mathcal{Z}(\mathcal{J})$, $\big(\mathcal{Z}(\mathcal{J}),*,(0,0\mathcal{J})\big)$ is $\mathcal{N}\mathcal{Z}$ **,** where
$\mathcal{Z}_{\xi}(\mathcal{J}) = \{(Ƨ,Ƨ\mathcal{J}) : Ƨ \in \mathcal{Z}\}$ Then $\mathcal{Z}_{\xi}(\mathcal{J})$is a $\mathcal{N}\mathcal{Z}^{s}$ of $\mathcal{Z}(\mathcal{J})$.

Proof: clearly $(0,0\mathcal{J}) \in \mathcal{Z}_{\xi}(\mathcal{J})$ and the third condition is satisfied for $\mathcal{Z}_{\xi}(\mathcal{J})$

Let $(ϯ,ϯ\mathcal{J}),(ꞗ,ꞗ\mathcal{J}) \in \mathcal{Z}_{\xi}(\mathcal{J}),\ ϯ,ꞗ \in \mathcal{Z} \Rightarrow$

$(ϯ,ϯ\mathcal{J}) * (ꞗ,ꞗ\mathcal{J}) = (ϯ * ꞗ,(ϯ * ꞗ)\mathcal{J})$

This shows that $(ϯ,ϯ\mathcal{J}) * (ꞗ,ꞗ\mathcal{J}) \in \mathcal{Z}_{\xi}(\mathcal{J})$

Then $\mathcal{Z}_{\xi}(\mathcal{J})$is a $\mathcal{N}\mathcal{Z}^{s}$ of $\mathcal{Z}(\mathcal{J})$.

Theorem 3.10: If $\mathcal{Z}_{\xi}(\mathcal{J}) \neq \phi$ and $\mathcal{Z}_{\xi}(\mathcal{J}) \subseteq \mathcal{Z}(\mathcal{J})$,$(\mathcal{Z}(\mathcal{J}),*,\circledast,(0,0\mathcal{J})$ is $\mathcal{N}\mathrm{P}\mathcal{Z}$ **,** where

$\mathcal{Z}_{\xi}(\mathcal{J}) = \{(Ƨ,Ƨ\mathcal{J}) : Ƨ \in \mathcal{Z}\}$ Then $\mathcal{Z}_{\xi}(\mathcal{J})$is a $\mathcal{N}\mathrm{P}\mathcal{Z}^{s}$ of $\mathcal{Z}(\mathcal{J})$.

Proof: it is easy as above.

Example 3.11: Let $*$ is a binary operation defined on $\mathcal{Z}_{\xi}(\mathcal{J}) = \{(0,0\mathcal{J}),(Ƨ,Ƨ\mathcal{J}),(ϯ,ϯ\mathcal{J}),(ϡ,ϡ\mathcal{J})\}$ as follows:

$*$	$(0,0\mathcal{J})$	$(Ƨ,Ƨ\mathcal{J})$	$(ϯ,ϯ\mathcal{J})$	$(ϡ,ϡ\mathcal{J})$
$(0,0\mathcal{J})$	$(0,0\mathcal{J})$	$(Ƨ,Ƨ\mathcal{J})$	$(ϯ,ϯ\mathcal{J})$	$(ϡ,ϡ\mathcal{J})$
$(Ƨ,Ƨ\mathcal{J})$	$(0,0\mathcal{J})$	$(Ƨ,Ƨ\mathcal{J})$	$(0,0\mathcal{J})$	$(Ƨ,Ƨ\mathcal{J})$
$(ϯ,ϯ\mathcal{J})$	$(0,0\mathcal{J})$	$(0,0\mathcal{J})$	$(ϯ,ϯ\mathcal{J})$	$(ϯ,ϯ\mathcal{J})$
$(ϡ,ϡ\mathcal{J})$	$(0,0\mathcal{J})$	$(Ƨ,Ƨ\mathcal{J})$	$(ϯ,ϯ\mathcal{J})$	$(ϡ,ϡ\mathcal{J})$

Then $\big(\mathcal{Z}_{\xi}(\mathcal{J}),*,(0,0\mathcal{J})\big)$ is a $\mathcal{N}\mathcal{Z}^{s}$ of $\mathcal{Z}(\mathcal{J})$

Theorem 3.12: Let $\big\{\mathcal{A}(\mathcal{J})_{\gamma} : \gamma \in \mathcal{S}\big\}$ and $\mathcal{A}(\mathcal{J})_{\gamma} \neq \phi$ be a collection of $\mathcal{N}\mathcal{Z}^{s}$ of $\mathcal{Z}(\mathcal{J})$ if

$$\bigcap_{\gamma\in\mathcal{S}}\mathcal{A}(\mathcal{J})_\gamma \neq \{(0,0\mathcal{J})\} \;\Rightarrow\; \bigcap_{\gamma\in\mathcal{S}}\mathcal{A}(\mathcal{J})_\gamma\ is\ \text{ a } \mathcal{NZ}^{s}\ of\ \mathcal{Z}(\mathcal{J})\,.$$

Proof: since $(0,0\mathcal{J}) \in \mathcal{A}(\mathcal{J})_\gamma, \forall\,\gamma \in \mathcal{S} \;\Rightarrow$

$$(0,0\mathcal{J}) \in \bigcap_{\gamma\in\mathcal{S}}\mathcal{A}(\mathcal{J})_\gamma \Rightarrow \bigcap_{\gamma\in\mathcal{S}}\mathcal{A}(\mathcal{J})_\gamma \neq \phi$$

And the third condition was achieved for $\mathcal{A}(\mathcal{J})_\gamma, \forall\,\gamma \in \mathcal{S} \Rightarrow$

The third condition was achieved for $\bigcap_{\gamma\in\mathcal{S}}\mathcal{A}(\mathcal{J})_\gamma$

$$\bigcap_{\gamma\in\mathcal{S}}\mathcal{A}(\mathcal{J})_\gamma \neq \{(0,0\mathcal{J})\} \;\Rightarrow \exists\,(\text{Ƨ},\text{Ƅ}\mathcal{J}) \in \bigcap_{\gamma\in\mathcal{S}}\mathcal{A}(\mathcal{J})_\gamma \Rightarrow (\text{Ƨ},\text{Ƅ}\mathcal{J}) \neq (0,0\mathcal{J}) \Rightarrow$$

$$\{(0,0\mathcal{J})\} \subseteq \bigcap_{\gamma\in\mathcal{S}}\mathcal{A}(\mathcal{J})_\gamma, \text{which is a Z} - \text{algebra}$$

Let $(\text{Ƨ},\text{Ƅ}\mathcal{J}), (\text{Ϯ},\text{Ч}\mathcal{J}) \in \bigcap_{\gamma\in\mathcal{S}}\mathcal{A}(\mathcal{J})_\gamma \Rightarrow (\text{Ƨ},\text{Ƅ}\mathcal{J}), (\text{Ϯ},\text{Ч}\mathcal{J}) \in \mathcal{A}(\mathcal{J})_\gamma, \forall\,\gamma \in \mathcal{S}$

Since $\mathcal{A}(\mathcal{J})_\gamma$ is a $\mathcal{NZ}^{s}, \forall\,\gamma \in \mathcal{S}$ of $\mathcal{Z}(\mathcal{J})$ then

$$(\text{Ƨ},\text{Ƅ}\mathcal{J}) * (\text{Ϯ},\text{Ч}\mathcal{J}) \in \mathcal{A}(\mathcal{J})_\gamma, \forall\,\gamma \in \mathcal{S}, \Rightarrow (\text{Ƨ},\text{Ƅ}\mathcal{J}) * (\text{Ϯ},\text{Ч}\mathcal{J}) \in \bigcap_{\gamma\in\mathcal{S}}\mathcal{A}(\mathcal{J})_\gamma$$

hence $\bigcap_{\gamma\in\mathcal{S}}\mathcal{A}(\mathcal{J})_\gamma$ is a $\mathcal{NZ}^{s}$ of $\mathcal{Z}(\mathcal{J})$.

Theorem 3.13: Let $\{\mathcal{A}(\mathcal{J})_\gamma : \gamma \in \mathcal{S}\}$ and $\mathcal{A}(\mathcal{J})_\gamma \neq \phi$ be a collection of $\mathcal{N}\mathrm{P}\mathcal{Z}^{s}\ of\ (\mathcal{Z}(\mathcal{J}),*,\circledast,(0,0\mathcal{J})$ is $\mathcal{N}\mathrm{P}\mathcal{Z}$ if

$$\bigcap_{\gamma\in\mathcal{S}}\mathcal{A}(\mathcal{J})_\gamma \neq \{(0,0\mathcal{J})\} \;\Rightarrow\; \bigcap_{\gamma\in\mathcal{S}}\mathcal{A}(\mathcal{J})_\gamma\ is\ \text{ a } \mathcal{N}\mathrm{P}\mathcal{Z}^{s}\ of\ \mathcal{Z}(\mathcal{J})\,.$$

Proof: it is easy as above.

Theorem 3.14: Let $\{\mathcal{A}(\mathcal{J})_\gamma : \gamma \in \mathcal{S}\}$ and $\mathcal{A}(\mathcal{J})_\gamma \neq \phi$ be a collection of $\mathcal{NZ}^{s}$ of $\mathcal{Z}(\mathcal{J})$ if $\mathcal{A}(\mathcal{J})_1 \subseteq \mathcal{A}(\mathcal{J})_2 \subseteq \cdots$ then

$$\bigcup_{\gamma\in\mathcal{S}}\mathcal{A}(\mathcal{J})_\gamma \text{ is a } \mathcal{NZ}^{s} \text{ of } \mathcal{Z}(\mathcal{J}).$$

Proof: obviously $(0,0\mathcal{J}) \in \bigcup_{\gamma\in\mathcal{S}}\mathcal{A}(\mathcal{J})_\gamma \neq \Phi \Rightarrow \exists\,(\text{Ƨ},\text{Ƅ}\mathcal{J}), (\text{Ϯ},\text{Ч}\mathcal{J}) \in \bigcup_{\gamma\in\mathcal{S}}\mathcal{A}(\mathcal{J})_\gamma$

$\Rightarrow$ For some $\gamma \in \mathcal{S}\ (\text{Ƨ},\text{Ƅ}\mathcal{J}), (\text{Ϯ},\text{Ч}\mathcal{J}) \in \mathcal{A}(\mathcal{J})_\gamma\ and\ (\text{Ƨ},\text{Ƅ}\mathcal{J}) * (\text{Ϯ},\text{Ч}\mathcal{J}) \in \mathcal{A}(\mathcal{J})_{\gamma\in\mathcal{S}}$

$$\Rightarrow (\text{Ƨ},\text{Ƅ}\mathcal{J}) * (\text{Ϯ},\text{Ч}\mathcal{J}) \in \bigcup_{\gamma\in\mathcal{S}}\mathcal{A}(\mathcal{J})_\gamma$$

Let $\mathfrak{S}(\mathcal{I})_{\gamma}$ be aproper sub set of $\mathcal{A}(\mathcal{I})_{\gamma}$, for some $\gamma \in \mathcal{S}$ which a Z- algebra, then for any $\gamma \in \mathcal{S}, \mathfrak{S}(\mathcal{I})_{\gamma} \in \bigcup_{\gamma \in \mathcal{S}} \mathcal{A}(\mathcal{I})_{\gamma}$ then

$\bigcup_{\gamma \in \mathcal{S}} \mathcal{A}(\mathcal{I})_{\gamma \in \mathcal{S}}$ is $\mathcal{NZ}^{s}$ of $\mathcal{Z}(\mathcal{I})$.

Theorem 3.15: Let $\{\mathcal{A}(\mathcal{I})_{\gamma} : \gamma \in \mathcal{S}\}$ and $\mathcal{A}(\mathcal{I})_{\gamma} \neq \phi$ be a collection of $\mathcal{N}\mathrm{P}\mathcal{Z}^{s}$ of $(\mathcal{Z}(\mathcal{I}), *, \circledast, (0, 0\mathcal{I})$ is $\mathcal{N}\mathrm{P}\mathcal{Z}$ if $\mathcal{A}(\mathcal{I})_1 \subseteq \mathcal{A}(\mathcal{I})_2 \subseteq \cdots$ then

$\bigcup_{\gamma \in \mathcal{S}} \mathcal{A}(\mathcal{I})_{\gamma}$ is $\mathcal{N}\mathrm{P}\mathcal{Z}^{s}$ of $\mathcal{Z}(\mathcal{I})$.

Proof: it is easy as above.

Definition 3.16: Let $\mathcal{D}(\mathcal{I}) \neq \phi$ and $\mathcal{D}(\mathcal{I}) \subseteq \mathcal{Z}(\mathcal{I})$, $(\mathcal{Z}(\mathcal{I}), *, (0, 0\mathcal{I}))$ is $\mathcal{NZ}$, $\mathcal{D}(\mathcal{I})$ is named a neutrosophic Z-ideal (briefly, $\mathcal{NZ}^{i}$) of $\mathcal{Z}(\mathcal{I})$ if :

1) $(0, 0\mathcal{I}) \in \mathcal{D}(\mathcal{I})$
2) If $(ꝛ, ƀ\mathcal{I}) * (ϯ, Ч\mathcal{I}) \in \mathcal{D}(\mathcal{I})$, and $(ϯ, Ч\mathcal{I}) \in \mathcal{D}(\mathcal{I}) \Rightarrow (ꝛ, ƀ\mathcal{I}) \in \mathcal{D}(\mathcal{I})$

Remark 3.17: Let $\mathcal{D}(\mathcal{I})$ is a $\mathcal{NZ}^{i}$ of $\mathcal{Z}(\mathcal{I})$ if

$(ϯ, Ч\mathcal{I}) \in \mathcal{D}(\mathcal{I})$ and $(ꝛ, ƀ\mathcal{I}) * (ϯ, Ч\mathcal{I}) = (0, 0\mathcal{I})$ then $(ꝛ, ƀ\mathcal{I}) \in \mathcal{D}(\mathcal{I})$.

Proof: let $(ϯ, Ч\mathcal{I}) \in \mathcal{D}(\mathcal{I})$ and $(ꝛ, ƀ\mathcal{I}) * (ϯ, Ч\mathcal{I}) = (0, 0\mathcal{I}) \Rightarrow$

$(ϯ, Ч\mathcal{I}) \in \mathcal{D}(\mathcal{I})$ and $(0, 0\mathcal{I}) \in \mathcal{D}(\mathcal{I}), (ꝛ, ƀ\mathcal{I}) * (ϯ, Ч\mathcal{I}) \in \mathcal{D}(\mathcal{I})$

Since $\mathcal{D}(\mathcal{I})$ is a $\mathcal{NZ}^{i}$ $\Rightarrow (ꝛ, ƀ\mathcal{I}) \in \mathcal{D}(\mathcal{I})$.

Definition 3.18: Let $\mathcal{D}(\mathcal{I}) \neq \phi$ and $\mathcal{D}(\mathcal{I}) \subseteq \mathcal{Z}(\mathcal{I})$,$(\mathcal{Z}(\mathcal{I}), *, \circledast, (0, 0\mathcal{I})$ is $\mathcal{N}\mathrm{P}\mathcal{Z}$,$\mathcal{D}(\mathcal{I})$ is named a neutrosophic pseudo Z-ideal (briefly, $\mathcal{N}\mathrm{P}\mathcal{Z}^{i}$) of $\mathcal{Z}(\mathcal{I})$ if :

1) $(0, 0\mathcal{I}) \in \mathcal{D}(\mathcal{I})$.
2) If $(ꝛ, ƀ\mathcal{I}) * (ϯ, Ч\mathcal{I}) \in \mathcal{D}(\mathcal{I})$, and $(ϯ, Ч\mathcal{I}) \in \mathcal{D}(\mathcal{I}) \Rightarrow (ꝛ, ƀ\mathcal{I}) \in \mathcal{D}(\mathcal{I})$

And $(ꝛ, ƀ\mathcal{I}) \circledast (ϯ, Ч\mathcal{I}) \in \mathcal{D}(\mathcal{I})$, and $(ϯ, Ч\mathcal{I}) \in \mathcal{D}(\mathcal{I}) \Rightarrow (ꝛ, ƀ\mathcal{I}) \in \mathcal{D}(\mathcal{I})$.

Definition 3.19: Let $\mathcal{D}(\mathcal{I}) \neq \phi$ and $\mathcal{D}(\mathcal{I}) \subseteq \mathcal{Z}(\mathcal{I})$, $(\mathcal{Z}(\mathcal{I}), *, (0, 0\mathcal{I}))$ is $\mathcal{NZ}$, $\mathcal{D}(\mathcal{I})$ is named a neutrosophic Z_1-ideal (briefly, $\mathcal{NZ}^{i1}$) of $\mathcal{Z}(\mathcal{I})$ if :

1) $(0, 0\mathcal{I}) \in \mathcal{D}(\mathcal{I})$
2) If $[((ꝛ, ƀ\mathcal{I}) * (ϡ, ɷ\mathcal{I})) * (ꝛ, ƀ\mathcal{I})] * (ϯ, Ч\mathcal{I}) \in \mathcal{D}(\mathcal{I})$, and $(ϯ, Ч\mathcal{I}) \in \mathcal{D}(\mathcal{I}) \Rightarrow (ꝛ, ƀ\mathcal{I}) \in \mathcal{D}(\mathcal{I}), \forall (ꝛ, ƀ\mathcal{I}), (ϡ, ɷ\mathcal{I}), (ϯ, Ч\mathcal{I}) \in \mathcal{Z}(\mathcal{I})$

Definition 3.20: Let $\mathcal{D}(\mathcal{I}) \neq \phi$ and $\mathcal{D}(\mathcal{I}) \subseteq \mathcal{Z}(\mathcal{I})$,$(\mathcal{Z}(\mathcal{I}), *, \circledast, (0, 0\mathcal{I})$ is $\mathcal{N}\mathrm{P}\mathcal{Z}$,$\mathcal{D}(\mathcal{I})$ is named a neutrosophic pseudo Z_1-ideal (briefly, $\mathcal{N}\mathrm{P}\mathcal{Z}^{i1}$) of $\mathcal{Z}(\mathcal{I})$ if :

1) $(0, 0\mathcal{I}) \in \mathcal{D}(\mathcal{I})$
2) $[((ꝛ, ƀ\mathcal{I}) * (ϡ, ɷ\mathcal{I})) * (ꝛ, ƀ\mathcal{I})] * (ϯ, Ч\mathcal{I}) \in \mathcal{D}(\mathcal{I})$, and $(ϯ, Ч\mathcal{I}) \in \mathcal{D}(\mathcal{I}) \Rightarrow (ꝛ, ƀ\mathcal{I}) \in \mathcal{D}(\mathcal{I}), \forall (ꝛ, ƀ\mathcal{I}), (ϡ, ɷ\mathcal{I}), (ϯ, Ч\mathcal{I}) \in \mathcal{Z}(\mathcal{I})$

And$\left[\left((Ƨ, ᶀ\mathcal{I}) \circledast (ኣ, ɷ\mathcal{I})\right) \circledast (Ƨ, ᶀ\mathcal{I})\right] \circledast (ϯ, Ч\mathcal{I}) \in \mathcal{D}(\mathcal{I})$, and $(ϯ, Ч\mathcal{I}) \in \mathcal{D}(\mathcal{I}) \Rightarrow (Ƨ, ᶀ\mathcal{I}) \in \mathcal{D}(\mathcal{I}), \forall\, (Ƨ, ᶀ\mathcal{I}), (ኣ, ɷ\mathcal{I}), (ϯ, Ч\mathcal{I}) \in \mathcal{Z}(\mathcal{I})$

Definition 3.21: Let $\mathcal{D}(\mathcal{I}) \neq \phi$ and $\mathcal{D}(\mathcal{I}) \subseteq \mathcal{Z}(\mathcal{I})$, $\left(\mathcal{Z}(\mathcal{I}), *, (0, 0\mathcal{I})\right)$ is $\mathcal{NZ}$, $\mathcal{D}(\mathcal{I})$ is named a neutrosophic Z_2-ideal (briefly, $\mathcal{NZ}^{i2}$) of $\mathcal{Z}(\mathcal{I})$ if :

1) $(0, 0\mathcal{I}) \in \mathcal{D}(\mathcal{I})$
2) If $[(Ƨ, ᶀ\mathcal{I}) * (ኣ, ɷ\mathcal{I})] * [(Ƨ, ᶀ\mathcal{I}) * (ϯ, Ч\mathcal{I})] \in \mathcal{D}(\mathcal{I})$, and $(ϯ, Ч\mathcal{I}) \in \mathcal{D}(\mathcal{I}) \Rightarrow (Ƨ, ᶀ\mathcal{I}) \in \mathcal{D}(\mathcal{I}), \forall\, (Ƨ, ᶀ\mathcal{I}), (ኣ, ɷ\mathcal{I}), (ϯ, Ч\mathcal{I}) \in \mathcal{Z}(\mathcal{I})$.

Definition 3.22: Let $\mathcal{D}(\mathcal{I}) \neq \phi$ and $\mathcal{D}(\mathcal{I}) \subseteq \mathcal{Z}(\mathcal{I})$, $(\mathcal{Z}(\mathcal{I}), *, \circledast, (0, 0\mathcal{I})$ is $\mathcal{N}\mathrm{P}\mathcal{Z}$, $\mathcal{D}(\mathcal{I})$ is named a neutrosophic pseudo Z_2-ideal (briefly, $\mathcal{N}\mathrm{P}\mathcal{Z}^{i2}$) of $\mathcal{Z}(\mathcal{I})$ if :

1) $(0, 0\mathcal{I}) \in \mathcal{D}(\mathcal{I})$
2) If $[(Ƨ, ᶀ\mathcal{I}) * (ኣ, ɷ\mathcal{I})] * [(Ƨ, ᶀ\mathcal{I}) * (ϯ, Ч\mathcal{I})] \in \mathcal{D}(\mathcal{I})$, and $(ϯ, Ч\mathcal{I}) \in \mathcal{D}(\mathcal{I}) \Rightarrow (Ƨ, ᶀ\mathcal{I}) \in \mathcal{D}(\mathcal{I}), \forall\, (Ƨ, ᶀ\mathcal{I}), (ኣ, ɷ\mathcal{I}), (ϯ, Ч\mathcal{I}) \in \mathcal{Z}(\mathcal{I})$

And $[(Ƨ, ᶀ\mathcal{I}) \circledast (ኣ, ɷ\mathcal{I})] \circledast [(Ƨ, ᶀ\mathcal{I}) \circledast (ϯ, Ч\mathcal{I})] \in \mathcal{D}(\mathcal{I})$, and $(ϯ, Ч\mathcal{I}) \in \mathcal{D}(\mathcal{I}) \Rightarrow (Ƨ, ᶀ\mathcal{I}) \in \mathcal{D}(\mathcal{I}), \forall\, (Ƨ, ᶀ\mathcal{I}), (ኣ, ɷ\mathcal{I}), (ϯ, Ч\mathcal{I}) \in \mathcal{Z}(\mathcal{I})$.

Definition 3.23: Let $\mathcal{D}(\mathcal{I}) \neq \phi$ and $\mathcal{D}(\mathcal{I}) \subseteq \mathcal{Z}(\mathcal{I})$, $\left(\mathcal{Z}(\mathcal{I}), *, (0, 0\mathcal{I})\right)$ is $\mathcal{NZ}$, $\mathcal{D}(\mathcal{I})$ is named a neutrosophic Z_q-ideal (briefly, $\mathcal{NZ}^{iq}$) of $\mathcal{Z}(\mathcal{I})$ if :

1) $(0, 0\mathcal{I}) \in \mathcal{D}(\mathcal{I})$
2) If $[(Ƨ, ᶀ\mathcal{I}) * (ኣ, ɷ\mathcal{I})] * [(ϯ, Ч\mathcal{I}) * (ኣ, ɷ\mathcal{I})] \in \mathcal{D}(\mathcal{I})$, and $(ϯ, Ч\mathcal{I}) \in \mathcal{D}(\mathcal{I}) \Rightarrow (Ƨ, ᶀ\mathcal{I}) \in \mathcal{D}(\mathcal{I}), \forall\, (Ƨ, ᶀ\mathcal{I}), (ኣ, ɷ\mathcal{I}), (ϯ, Ч\mathcal{I}) \in \mathcal{Z}(\mathcal{I})$

Definition 3.24: Let $\mathcal{D}(\mathcal{I}) \neq \phi$ and $\mathcal{D}(\mathcal{I}) \subseteq \mathcal{Z}(\mathcal{I})$, $(\mathcal{Z}(\mathcal{I}), *, \circledast, (0, 0\mathcal{I})$ is $\mathcal{N}\mathrm{P}\mathcal{Z}$, $\mathcal{D}(\mathcal{I})$ is named a neutrosophic pseudo Z_q ideal (briefly, $\mathcal{N}\mathrm{P}\mathcal{Z}^{iq}$) of $\mathcal{Z}(\mathcal{I})$ if :

1) $(0, 0\mathcal{I}) \in \mathcal{D}(\mathcal{I})$
2) If $[(Ƨ, ᶀ\mathcal{I}) * (ኣ, ɷ\mathcal{I})] * [(ϯ, Ч\mathcal{I}) * (ኣ, ɷ\mathcal{I})] \in \mathcal{D}(\mathcal{I})$, and $(ϯ, Ч\mathcal{I}) \in \mathcal{D}(\mathcal{I}) \Rightarrow (Ƨ, ᶀ\mathcal{I}) \in \mathcal{D}(\mathcal{I}), \forall\, (Ƨ, ᶀ\mathcal{I}), (ኣ, ɷ\mathcal{I}), (ϯ, Ч\mathcal{I}) \in \mathcal{Z}(\mathcal{I})$

And $[(Ƨ, ᶀ\mathcal{I}) \circledast (ኣ, ɷ\mathcal{I})] \circledast [(ϯ, Ч\mathcal{I}) \circledast (ኣ, ɷ\mathcal{I})] \in \mathcal{D}(\mathcal{I})$, and $(ϯ, Ч\mathcal{I}) \in \mathcal{D}(\mathcal{I}) \Rightarrow (Ƨ, ᶀ\mathcal{I}) \in \mathcal{D}(\mathcal{I}), \forall\, (Ƨ, ᶀ\mathcal{I}), (ኣ, ɷ\mathcal{I}), (ϯ, Ч\mathcal{I}) \in \mathcal{Z}(\mathcal{I})$

Definition 3.25: Let $\mathcal{D}_\xi(\mathcal{I}) \neq \phi$ and $\mathcal{D}_\xi(\mathcal{I}) \subseteq \mathcal{Z}_\xi(\mathcal{I})$, $\mathcal{D}_\xi(\mathcal{I})$ is named a neutrosophic Z-ideal (briefly, $\mathcal{NZ}^{\xi i}$) of $\mathcal{Z}_\xi(\mathrm{I})$ if :

1) $(0, 0\mathcal{I}) \in \mathcal{D}_\xi(\mathcal{I})$
2) If $(Ƨ, Ƨ\mathcal{I}) * [(ϯ, ϯ\mathcal{I}) * (ኣ, ኣ\mathcal{I})] \in \mathcal{D}_\xi(\mathcal{I})$, and $(ϯ, ϯ\mathcal{I}) \in \mathcal{D}_\xi(\mathcal{I})$
$\Rightarrow (Ƨ, Ƨ\mathcal{I}) * (ኣ, ኣ\mathcal{I}) \in \mathcal{D}_\xi(\mathcal{I}),\ \forall\, (Ƨ, Ƨ\mathcal{I}), (ϯ, ϯ\mathcal{I}), (ኣ, ኣ\mathcal{I})\, \mathcal{D}_\xi(\mathcal{I})$

Theorem 3.26: Every $\mathcal{NZ}^{\xi i}$ of $\mathcal{X}_\xi(\mathcal{I})$ is a $\mathcal{NZ}^{i}$ of $\mathcal{X}_\xi(\mathcal{I})$.

Proof: suppose that $(Ƨ, Ƨ\mathcal{I}) = (0, 0\mathcal{I})$ in 2 $\Rightarrow$ it's proofed. .

Definition 3.27: Let $\mathcal{D}(\mathcal{I}) \neq \phi$ and $\mathcal{D}(\mathcal{I}) \subseteq \mathcal{Z}(\mathcal{I})$, $\left(\mathcal{Z}(\mathcal{I}), *, (0, 0\mathcal{I})\right)$ is $\mathcal{NZ}$,$\mathcal{D}(\mathcal{I})$ is named a neutrosophic Z-filter (briefly, $\mathcal{NZ}^{f}$) of $\mathcal{Z}(\mathcal{I})$if :

1) $(0,0\mathcal{I}) \notin \mathcal{D}(\mathcal{I})$
2) $\forall\, (Ƨ, ƅ\mathcal{I}), (†, Ч\mathcal{I}) \in \mathcal{D}(\mathcal{I})$and $(Ƨ, ƅ\mathcal{I}) \neq (†, Ч\mathcal{I}) \Rightarrow$
   $(Ƨ, ƅ\mathcal{I})Ϫ(†, Ч\mathcal{I}) = (Ƨ, ƅ\mathcal{I}) * [(Ƨ, ƅ\mathcal{I}) * (†, Ч\mathcal{I})] \in \mathcal{D}(\mathcal{I})$

Definition 3.28: Let $\mathcal{D}(\mathcal{I}) \neq \phi$ and $\mathcal{D}(\mathcal{I}) \subseteq \mathcal{Z}(\mathcal{I})$,$(\mathcal{Z}(\mathcal{I}),*,\circledast,(0,0\mathcal{I})$ is $\mathcal{N}\mathrm{P}\mathcal{Z}$,$\mathcal{D}(\mathcal{I})$ is named a neutrosophic pseudo Z-filter (briefly, $\mathcal{N}\mathrm{P}\mathcal{Z}^f$) of $\mathcal{Z}(\mathcal{I})$if :

1) $(0,0\mathcal{I}) \notin \mathcal{D}(\mathcal{I})$
2) $\forall\, (Ƨ, ƅ\mathcal{I}), (†, Ч\mathcal{I}) \in \mathcal{D}(\mathcal{I})$and $(Ƨ, ƅ\mathcal{I}) \neq (†, Ч\mathcal{I}) \Rightarrow$
   $(Ƨ, ƅ\mathcal{I})Ϫ(†, Ч\mathcal{I}) = (Ƨ, ƅ\mathcal{I}) * [(Ƨ, ƅ\mathcal{I}) * (†, Ч\mathcal{I})] \in \mathcal{D}(\mathcal{I})$

And $\forall\, (Ƨ, ƅ\mathcal{I}), (†, Ч\mathcal{I}) \in \mathcal{D}(\mathcal{I})$and $(Ƨ, ƅ\mathcal{I}) \neq (†, Ч\mathcal{I}) \Rightarrow$
$(Ƨ, ƅ\mathcal{I})Ϫ(†, Ч\mathcal{I}) = (Ƨ, ƅ\mathcal{I}) \circledast [(Ƨ, ƅ\mathcal{I}) \circledast (†, Ч\mathcal{I})] \in \mathcal{D}(\mathcal{I})$

Definition 3.29: If $(\mathcal{Z}(\mathcal{I}),*,(0,0\mathcal{I}))$ & $\left(\acute{\mathcal{Z}}(\mathcal{I}),\acute{*},(\acute{0},\acute{0}\mathcal{I})\right)$ be two $\mathcal{N}\mathcal{Z}$, a mapping $f: \mathcal{Z}(\mathcal{I}) \to \acute{\mathcal{Z}}(\mathcal{I})$is named a neutrosophic Z- homomorphism (briefly, $\mathcal{N}\mathcal{Z}^{\hbar}$) if satisfied

1) $f[(Ƨ, ƅ\mathcal{I}) * (†, Ч\mathcal{I})] = f(Ƨ, ƅ\mathcal{I}) \acute{*} f(†, Ч\mathcal{I}), \forall (Ƨ, ƅ\mathcal{I}), (†, Ч\mathcal{I}) \in \mathcal{Z}(\mathcal{I})$
2) $f(0,0\mathcal{I}) = (\acute{0},\acute{0}\mathcal{I})$
3) If f is 1-1 ⇒ f is named a neutrosophic Z- monomorphism.
4) If f is onto ⇒ f is named a neutrosophic Z- epimorphism.
5) If f is 1-1 and onto ⇒ f is named a neutrosophic Z-isomorphism.

Definition 3.30: If $(\mathcal{Z}(\mathcal{I}),*,\circledast,(0,0\mathcal{I}))$ & $\left(\acute{\mathcal{Z}}(\mathcal{I}),\acute{*},\acute{\circledast},(\acute{0},\acute{0}\mathcal{I})\right)$ be two $\mathcal{N}\mathrm{P}\mathcal{Z}$, a mapping $f: \mathcal{Z}(\mathcal{I}) \to \acute{\mathcal{Z}}(\mathcal{I})$is named a neutrosophic pseudo Z- homomorphism (briefly, $\mathcal{N}\mathrm{P}\mathcal{Z}^{\hbar}$) if satisfied

1) $f[(Ƨ, ƅ\mathcal{I}) * (†, Ч\mathcal{I})] = f(Ƨ, ƅ\mathcal{I}) \acute{*} f(†, Ч\mathcal{I}), \forall (Ƨ, ƅ\mathcal{I}), (†, Ч\mathcal{I}) \in \mathcal{Z}(\mathcal{I})$
2) $f[(Ƨ, ƅ\mathcal{I}) \circledast (†, Ч\mathcal{I})] = f(Ƨ, ƅ\mathcal{I}) \acute{\circledast} f(†, Ч\mathcal{I}), \forall (Ƨ, ƅ\mathcal{I}), (†, Ч\mathcal{I}) \in \mathcal{Z}(\mathcal{I})$
3) $f(0,0\mathcal{I}) = (\acute{0},\acute{0}\mathcal{I})$
4) If f is 1-1 ⇒ f is named ”a neutrosophic pseudo Z- monomorphism”.
5) If f is onto ⇒ f is named ”a neutrosophic pseudo Z- epimorphism”.
6) If f is 1-1 and onto ⇒ f is named a neutrosophic pseudo Z-isomorphism.

Theorem 3.31: Let $\mathcal{Z}(\mathcal{I})$ & $\acute{\mathcal{Z}}(\mathcal{I})$ be two $\mathcal{N}\mathcal{Z}$, $f: \mathcal{Z}(\mathcal{I}) \to \acute{\mathcal{Z}}(\mathcal{I})$ be a neutrosophic Z- epimorphism .If $\mathcal{D}(\mathcal{I})$is a $\mathcal{N}\mathcal{Z}^f$ of $\mathcal{Z}(\mathcal{I}) \Rightarrow f(\mathcal{D}(\mathcal{I}))$ is a $\mathcal{N}\mathcal{Z}^f$ of $\acute{\mathcal{Z}}(\mathcal{I})$.

Proof: let $(Ƨ, ƅ\mathcal{I}), (†, Ч\mathcal{I}) \in f(\mathcal{D}(\mathcal{I})) \Rightarrow$

$(Ƨ, ƅ\mathcal{I}) = f\,(ϡ, ɷ\mathcal{I})$, $(†, Ч\mathcal{I}) = f(Ϙ, Є\,\mathcal{I})$ where $(ϡ, ɷ\mathcal{I}), (Ϙ, Є\,\mathcal{I}) \in \mathcal{D}(\mathcal{I})$

Since $\mathcal{D}(\mathcal{I})$is a $\mathcal{N}\mathcal{Z}^f$ of $\mathcal{Z}(\mathcal{I}), \Rightarrow$

$(ϡ, ɷ\mathcal{I})Ϫ(Ϙ, Є\,\mathcal{I}) = (ϡ, ɷ\mathcal{I}) * [(ϡ, ɷ\mathcal{I}) * (Ϙ, Є\,\mathcal{I})] \in \mathcal{D}(\mathcal{I})$

Also $f\big((ϡ, ɷ\mathcal{I})Ϫ(ʒ, ŋ\mathcal{I})\big) \in f(\mathcal{D}(\mathcal{I}))$

$$\begin{aligned}
(Ƨ, ƅ\mathcal{I})Ϫ(†, Ч\mathcal{I}) &= (Ƨ, ƅ\mathcal{I}) * \big((Ƨ, ƅ\mathcal{I}) * (†, Ч\mathcal{I})\big) \\
&= f\,(ϡ, ɷ\mathcal{I}) \acute{*} \big(f\,(ϡ, ɷ\mathcal{I}) \acute{*} f\,(Ϙ, Є\,\mathcal{I})\big) \\
&= f\,\big[(ϡ, ɷ\mathcal{I}) * \big((ϡ, ɷ\mathcal{I}) * (Ϙ, Є\,\mathcal{I})\big)\big] \\
&= f\,[(ϡ, ɷ\mathcal{I})\Delta\,(Ϙ, Є\,\mathcal{I})]
\end{aligned}$$

$(Ƨ, ƅ\mathcal{I})Ϫ(†, Ч\mathcal{I}) \in f(\mathcal{D}(\mathcal{I})) \Rightarrow$
$f(\mathcal{D}(\mathcal{I}))$ is a $\mathcal{N}\mathcal{Z}^f$ of $\acute{\mathcal{Z}}(\mathcal{I})$.

Theorem 3.32: Let $\mathcal{Z}(\mathcal{I})$ & $\acute{\mathcal{Z}}(\mathcal{I})$ be two $\mathcal{N}\mathrm{P}\mathcal{Z}$, $f: \mathcal{Z}(\mathcal{I}) \rightarrow \acute{\mathcal{Z}}(\mathcal{I})$ be a neutrosophic pseudo Z- epimorphism .If $\mathcal{D}(\mathcal{I})$is a $\mathcal{N}\mathrm{P}\mathcal{Z}^{f}$ of $\mathcal{Z}(\mathcal{I}) \Rightarrow f(\mathcal{D}(\mathcal{I}))$ is a $\mathcal{N}\mathrm{P}\mathcal{Z}^{f}$ of $\acute{\mathcal{Z}}(\mathcal{I})$.

Proof: it is easy as above.

Definition 3.33: Let $f: \mathcal{Z}(\mathcal{I}) \rightarrow \acute{\mathcal{Z}}(\mathcal{I})$ be a $\mathcal{N}\mathcal{Z}^{\hbar}$ then $\ker(f) = \{(\text{Ƨ}, \text{ƀ}\mathcal{I}) \in \mathcal{Z}(\mathcal{I}): f(\text{Ƨ}, \text{ƀ}\mathcal{I}) = (\acute{0}, \acute{0}\mathcal{I})\}$ is named the kernel of f.

Definition 3.34: Let $f: \mathcal{Z}(\mathcal{I}) \rightarrow \acute{\mathcal{Z}}(\mathcal{I})$ be a $\mathcal{N}\mathrm{P}\mathcal{Z}^{\hbar}$ then

$\ker(f) = \{(\text{Ƨ}, \text{ƀ}\mathcal{I}) \in \mathcal{Z}(\mathcal{I}): f(\text{Ƨ}, \text{ƀ}\mathcal{I}) = (\acute{0}, \acute{0}\mathcal{I})\}$ is named the kernel of f .

Remark 3.35: (1) Let $f: \mathcal{Z}(\mathcal{I}) \rightarrow \acute{\mathcal{Z}}(\mathcal{I})$ is a $\mathcal{N}\mathcal{Z}^{\hbar}$, then $\ker(f)$ is not a $\mathcal{N}\mathcal{Z}^{f}$ of $\mathcal{Z}(\mathcal{I})$.
(2) $\mathcal{N}\mathcal{Z}^{f}$ is not $\mathcal{N}\mathcal{Z}^{i}$ and conversely .
(3) $\mathcal{N}\mathcal{Z}^{f}$ is not $\mathcal{N}\mathcal{Z}^{s}$ and conversely .

Remark 3.36: (1) Let $f: \mathcal{Z}(\mathcal{I}) \rightarrow \acute{\mathcal{Z}}(\mathcal{I})$ is a $\mathcal{N}\mathrm{P}\mathcal{Z}^{\hbar}$, then $\ker(f)$ is not a $\mathcal{N}\mathrm{P}\mathcal{Z}^{f}$ of $\mathcal{Z}(\mathcal{I})$.
(2) $\mathcal{N}\mathrm{P}\mathcal{Z}^{f}$ is not $\mathcal{N}\mathrm{P}\mathcal{Z}^{i}$ and conversely .
(3) $\mathcal{N}\mathrm{P}\mathcal{Z}^{f}$ is not $\mathcal{N}\mathrm{P}\mathcal{Z}^{s}$ and conversely .

Theorem 3.37: Let $f: \mathcal{Z}(\mathcal{I}) \rightarrow \acute{\mathcal{Z}}(\mathcal{I})$ be a $\mathcal{N}\mathcal{Z}^{\hbar}$ then

1) If the identity of $\mathcal{Z}(\mathcal{I})$ is $(0,0\mathcal{I}) \Rightarrow$ the identity of $\acute{\mathcal{Z}}(\mathcal{I})$ is $f(0,0\mathcal{I})$.
2) If $\mathcal{U}$ is a $\mathcal{N}\mathcal{Z}^{s}$ of $\mathcal{Z}(\mathcal{I})$, then $f(\mathcal{U})$ is a $\mathcal{N}\mathcal{Z}^{s}$of $\acute{\mathcal{Z}}(\mathcal{I})$.
3) If $\mathcal{U}$ is a $\mathcal{N}\mathcal{Z}^{s}$ of $\acute{\mathcal{Z}}(\mathcal{I})$, then $f^{-1}(\mathcal{U})$ is a $\mathcal{N}\mathcal{Z}^{s}$of $\mathcal{Z}(\mathcal{I})$.

Proof: it's clear.

Theorem 3.38: Let $f: \mathcal{Z}(\mathcal{I}) \rightarrow \acute{\mathcal{Z}}(\mathcal{I})$ be a $\mathcal{N}\mathrm{P}\mathcal{Z}^{\hbar}$ then

1) If the identity of $\mathcal{Z}(\mathcal{I})$ is $(0,0\mathcal{I}) \Rightarrow$ the identity of $\acute{\mathcal{Z}}(\mathcal{I})$ is $f(0,0\mathcal{I})$.
2) If $\mathcal{U}$ is a $\mathcal{N}\mathrm{P}\mathcal{Z}^{s}$ of $\mathcal{Z}(\mathcal{I})$, then $f(\mathcal{U})$ is a $\mathcal{N}\mathrm{P}\mathcal{Z}^{s}$of $\acute{\mathcal{Z}}(\mathcal{I})$.
3) If $\mathcal{U}$ is a $\mathcal{N}\mathrm{P}\mathcal{Z}^{s}$ of $\acute{\mathcal{Z}}(\mathcal{I})$, then $f^{-1}(\mathcal{U})$ is a $\mathcal{N}\mathrm{P}\mathcal{Z}^{s}$of $\mathcal{Z}(\mathcal{I})$.

Proof: it's clear.

Theorem 3.39: Let $f: \mathcal{Z}(\mathcal{I}) \rightarrow \acute{\mathcal{Z}}(\mathcal{I})$ is a $\mathcal{N}\mathcal{Z}^{\hbar}$ then f is a neutrosophic Z- monomorphism $\Leftrightarrow \ker(f) = \{(0,0I)\}$

Proof: it's clear.

Theorem 3.40: Let $f: \mathcal{Z}(\mathcal{I}) \rightarrow \acute{\mathcal{Z}}(\mathcal{I})$ is a $\mathcal{N}\mathrm{P}\mathcal{Z}^{\hbar}$ then f is a neutrosophic Z- monomorphism $\Leftrightarrow \ker(f) = \{(0,0I)\}$

Proof: it's clear.

Theorem 3.41: Let $f: \mathcal{Z}(\mathcal{I}) \rightarrow \acute{\mathcal{Z}}(\mathcal{I})$ is a $\mathcal{N}\mathcal{Z}^{\hbar}$ then $\ker(f)$ is a $\mathcal{N}\mathcal{Z}^{i}$ of $\mathcal{Z}(\mathcal{I})$.

Proof: $f(0,0\mathcal{I}) = (\acute{0}, \acute{0}\mathcal{I}) \Rightarrow (0,0\mathcal{I}) \in \ker(f)$

Let $(\text{Ƨ}, \text{ƀ}\mathcal{I}) * [(\dagger, \text{Ч}\mathcal{I}) * (\text{ኣ}, \omega\mathcal{I})] \in \ker(f)$ and $(\dagger, \text{Ч}\mathcal{I}) \in \ker(f) \Rightarrow$

$$f((\text{Ƨ}, \text{ƀ}\mathcal{I}) * [(\dagger, \text{Ч}\mathcal{I}) * (\text{ኣ}, \omega\mathcal{I})]) = (\acute{0}, \acute{0}\mathcal{I}) \text{ and } f(\dagger, \text{Ч}\mathcal{I}) = (\acute{0}, \acute{0}\mathcal{I})$$

$$\begin{aligned}(\acute{0}, \acute{0}\mathcal{I}) &= f((\text{Ƨ}, \text{ƀ}\mathcal{I}) * [(\dagger, \text{Ч}\mathcal{I}) * (\text{ኣ}, \omega\mathcal{I})]) \\ &= f(\text{Ƨ}, \text{ƀ}\mathcal{I}) \acute{*} [f(\dagger, \text{Ч}\mathcal{I}) \acute{*} f(\text{ኣ}, \omega\mathcal{I})] \\ &= f(\text{Ƨ}, \text{ƀ}\mathcal{I}) \acute{*} [(\acute{0}, \acute{0}\mathcal{I}) \acute{*} f(\text{ኣ}, \omega\mathcal{I})]\end{aligned}$$

$$= f(\text{Ꙅ}, \text{ᶀ}\mathcal{J}) \acute{*} f(\text{ƛ}, \text{ɷ}\mathcal{J})$$
$$= f\big((\text{Ꙅ}, \text{ᶀ}\mathcal{J}) * (\text{ƛ}, \text{ɷ}\mathcal{J})\big)$$

We get $\big((\text{Ꙅ}, \text{ᶀ}\mathcal{J}) * (\text{ƛ}, \text{ɷ}\mathcal{J})\big) \in \ker(f)$.then $\ker(f)$ is a a $\mathcal{N}\mathcal{Z}^{i}$ of $\mathcal{Z}(\mathcal{J})$.

Theorem 3.42: Let $f: \mathcal{Z}(\mathcal{J}) \to \acute{\mathcal{Z}}(\mathcal{J})$ is a $\mathcal{N}\mathrm{P}\mathcal{Z}^{\hbar}$ then $\ker(f)$ is a $\mathcal{N}\mathrm{P}\mathcal{Z}^{i}$ of $\mathcal{Z}(\mathcal{J})$.

Proof: it is easy as above.

4 Conclusion

We discussed the idea of a neutrosophic Z-algebra and neutrosophic $\mathrm{pseudoZ} - \mathrm{algebra}$ looked into some of its properties, and the concept of neutrosophic Z-ideal, neutrosophic Z-sub algebra, neutrosophic Z-filter and neutrosophic Z- homomorphism are studied and a few properties are obtained.

Competing Interests

Authors have declared that no competing interests exist.

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